84 Radar Evaluation Squadron

Site Evaluation Section

Hill Air Force Base, Utah

What is covered

- Site Evaluation Mission
- Our Customers
- Hardware
- Software
- In-Field Activities
- Post-Field Activities

Site Evaluation Mission

- Surveys proposed and existing radar sites in support of expeditionary, homeland defense and counter narcotics operations for radar programs valued in excess of $11B. Maintains parameters of radars worldwide in a Geographic Information System database to model radar coverage for DoD, Department of Homeland Security, Immigrations and Customs Enforcement, and Federal Aviation Administration (FAA). Maps radar site specific information to ensure all aspects of sensor positioning are established. Determines physical radar horizon by identifying man-made structures and terrain features that impact radar coverage. Combines field data with digital terrain elevation models to depict theoretical radar coverage. Performs desktop coverage studies for MAJCOMs and DoD organizations including the Joint Theater Air and Missile Defense Organization

Customers

- DOD (Department of Defense)
- FAA (Federal Aviation Administration)
- JTAMDO (Joint Theater Air Missile Defense Organization)
- NORAD (North America Aerospace Defense Command)
- DEA (Drug Enforcement Agency)

Hardware

- Total Station
  - Topcon GTS-311
- GPS
  - Trimble GeoXT
- Data Collector
  - Trimble GeoXT
- Lap-top Computer

Software

- RCP (Radar Coverage Prediction)
  - DTED (Digital Terrain Elevation Data) Levels 0,1,2
  - DCW (Digital Chart of the World)
- RCVA (Radar Coverage Viewing Application)
- FDAS (Field Data Analysis Software)
- Sun Location
- Sight Survey 4.0
- PowerPoint
- Excel
- RCPTU (Radar Coverage Prediction Tool Upgrade)

In-field Activities

- Orientation to True North
- Triangulation
- 360° Screening
- Panoramic pictures of horizon
- GPS
- Data Analysis

Orientation to True North

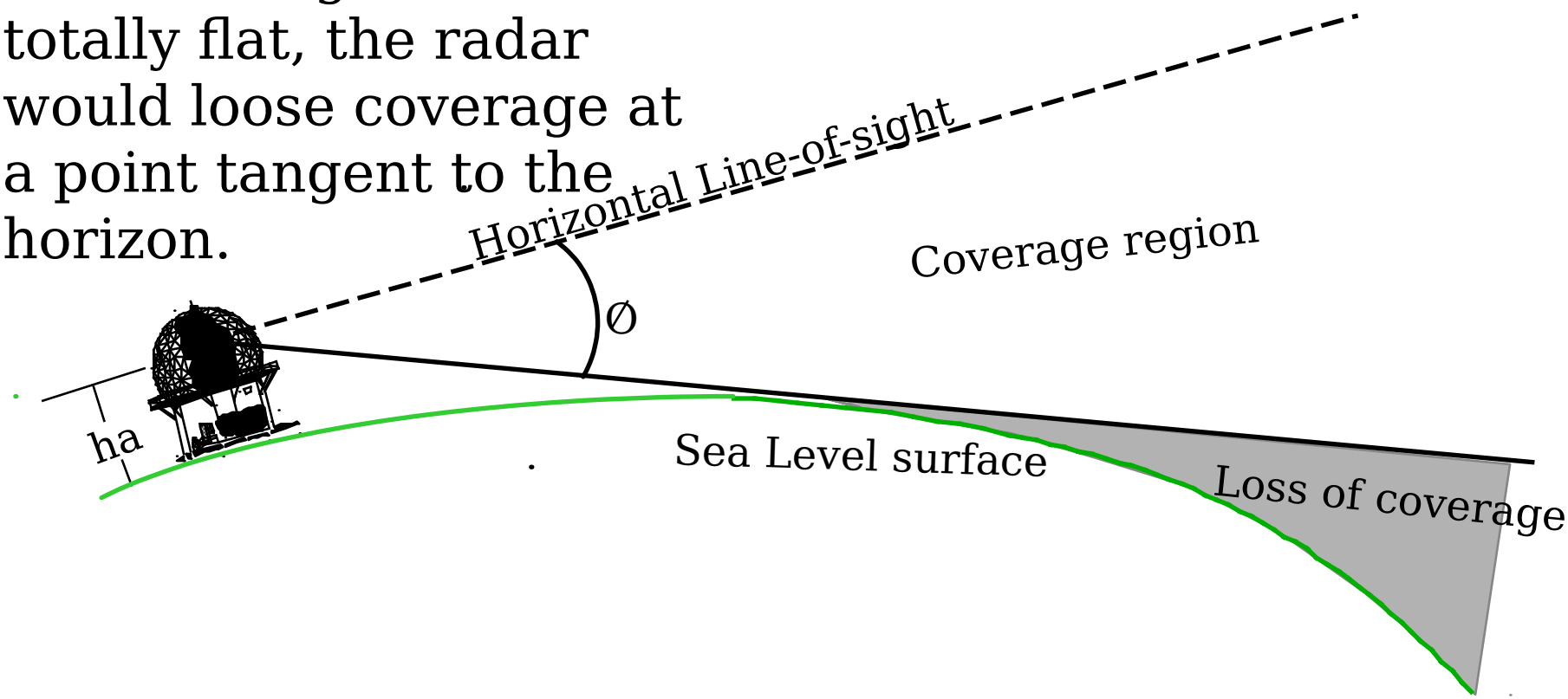
- Sun Shots (solar azimuth)
- Baseline is established
- Screening setup points established from baseline (triangulation)

Solar Azimuth

- GPS Sun Location Program synchronized with UTC time
- Setup location (lat/lon) entered into Sun Location Program
- Solar Azimuth recorded
- Baseline Azimuth recorded
- Repeated six times for average

EARTH CURVATURE SCREENING

If the terrain surrounding a site was totally flat, the radar would loose coverage at a point tangent to the horizon.

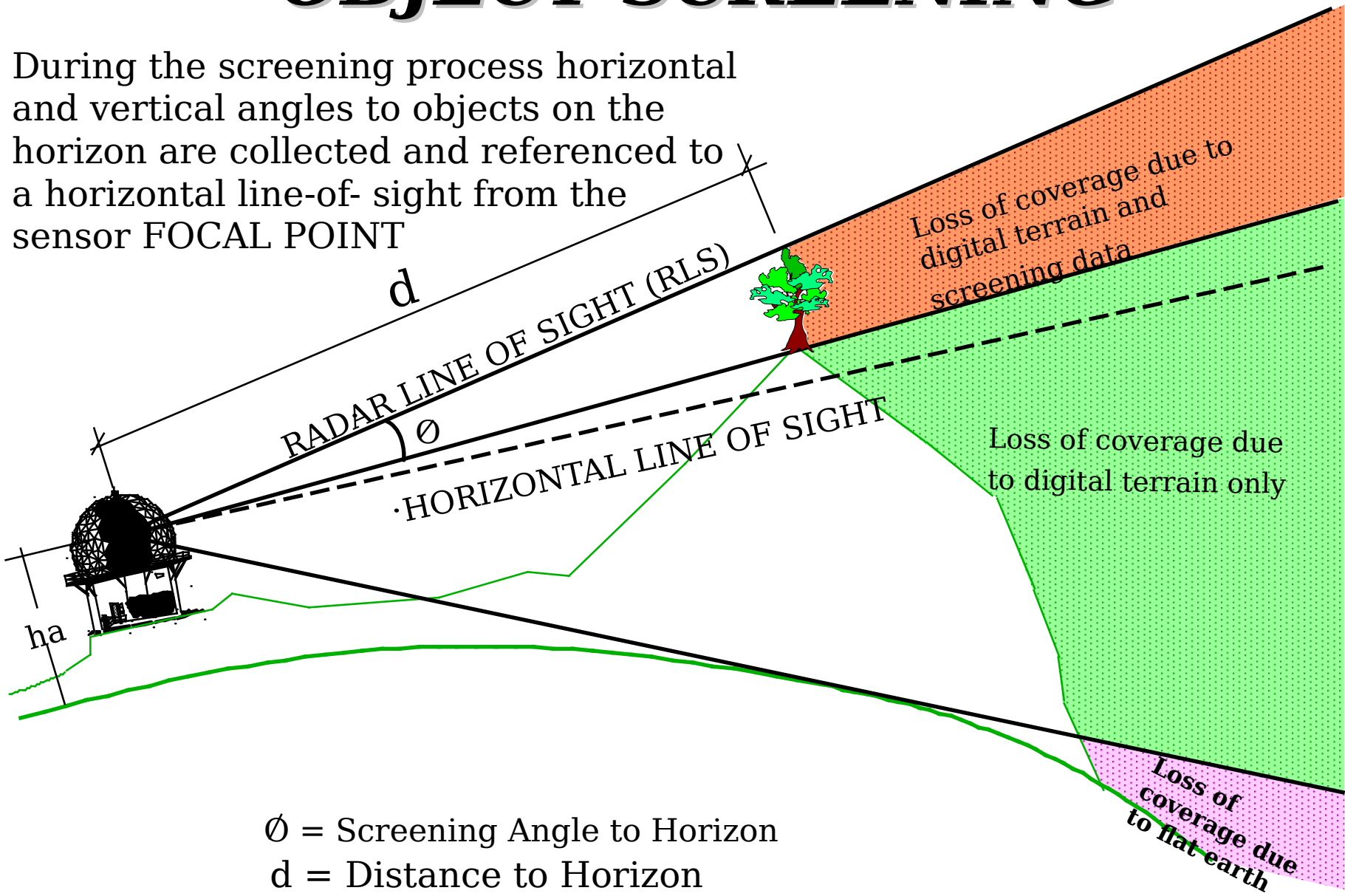


Ø = Screen angle to Sea level horizon

ha = Antenna height in feet above sea level

OBJECT SCREENING

During the screening process horizontal and vertical angles to objects on the horizon are collected and referenced to a horizontal line-of- sight from the sensor FOCAL POINT


d
RADAR LINE OF SIGHT (RLS)
Ø
HORIZONTAL LINE OF SIGHT
Loss of coverage due to digital terrain and screening data
Loss of coverage due to digital terrain only
Loss of coverage due to flat earth
ha

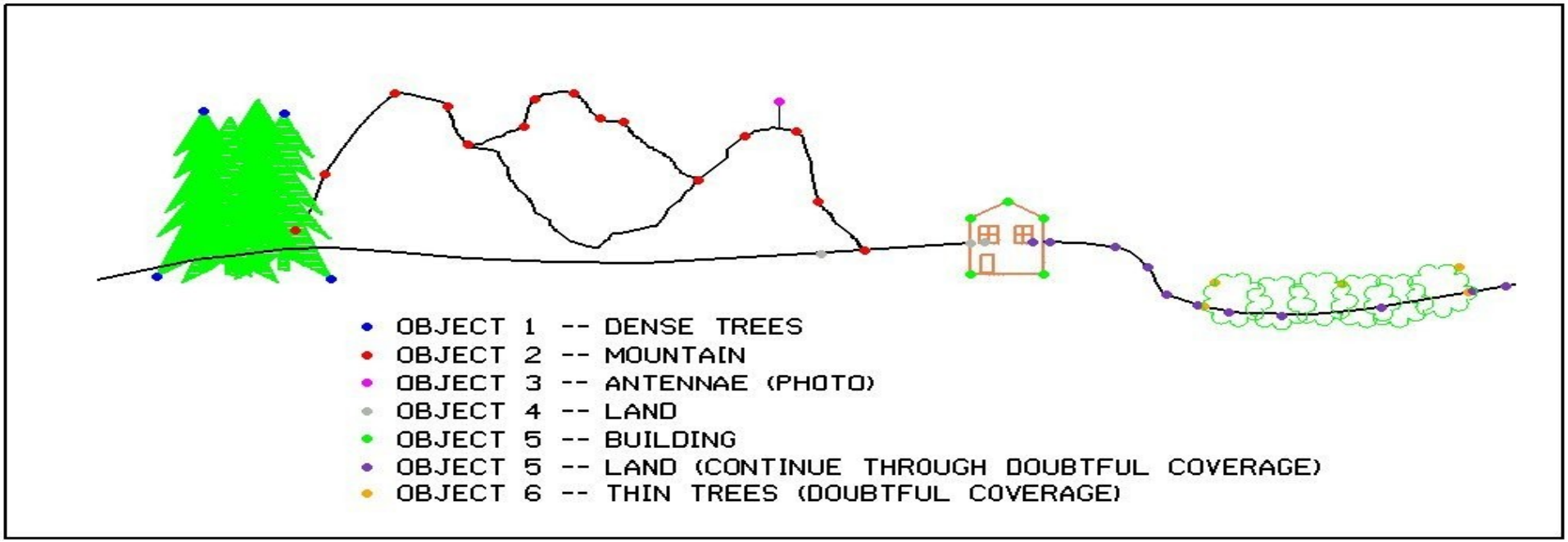
Ø = Screening Angle to Horizon

d = Distance to Horizon

ha = Antenna height in feet above sea level

Accomplish Screening

Screening consist of collecting the horizontal and vertical angles of points on the horizon, to depict the shape of objects that may affect the radar coverage.


OBJECT 1 -- DENSE TREES
OBJECT 2 -- MOUNTAIN
OBJECT 3 -- ANTENNAE (PHOTO)
OBJECT 4 -- LAND
OBJECT 5 -- BUILDING
OBJECT 5 -- LAND (CONTINUE THROUGH DOUBTFUL COVERAGE)
OBJECT 6 -- THIN TREES (DOUBTFUL COVERAGE)

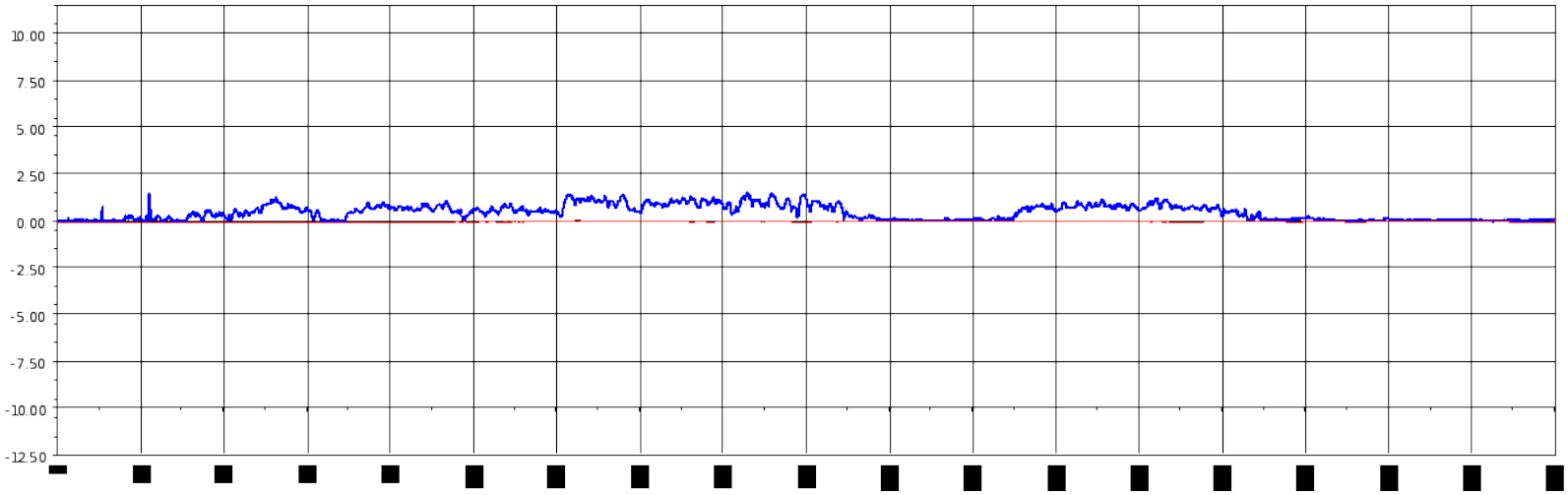
Olmstead Equation

- Used in RCP to create RCV files
- Determines the angle to an object of known altitude and distance from the observer, taking refractivity of the earth’s curvature into account.

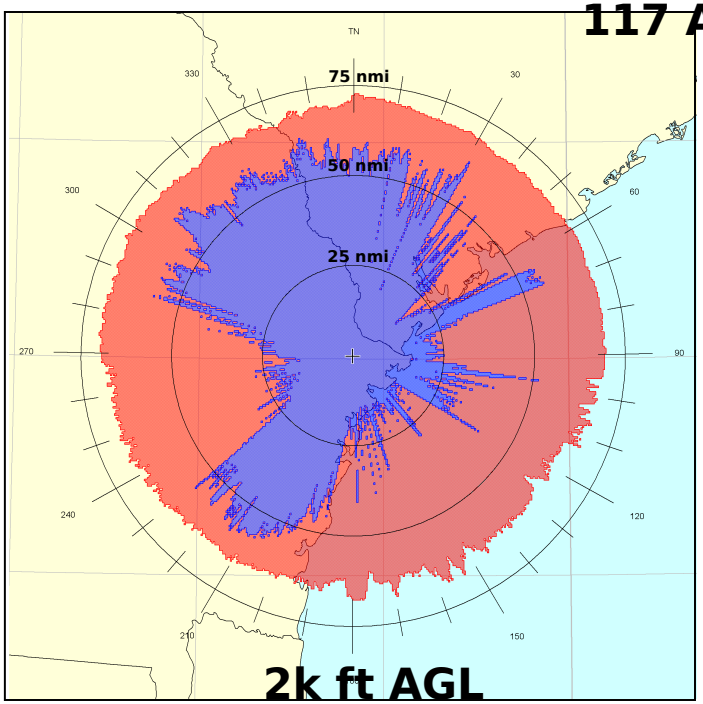
Post-field Activities

- RCP
  - Create RCV (Radar Coverage Volume) file with DTED only
- FDAS
  - Combine survey data with DTED RCV file
  - Export new RCV file
- RCVA
  - Create radar coverage
- Products
  - Coverage Diagrams
  - Skyline Graphs

Skyline Comparison

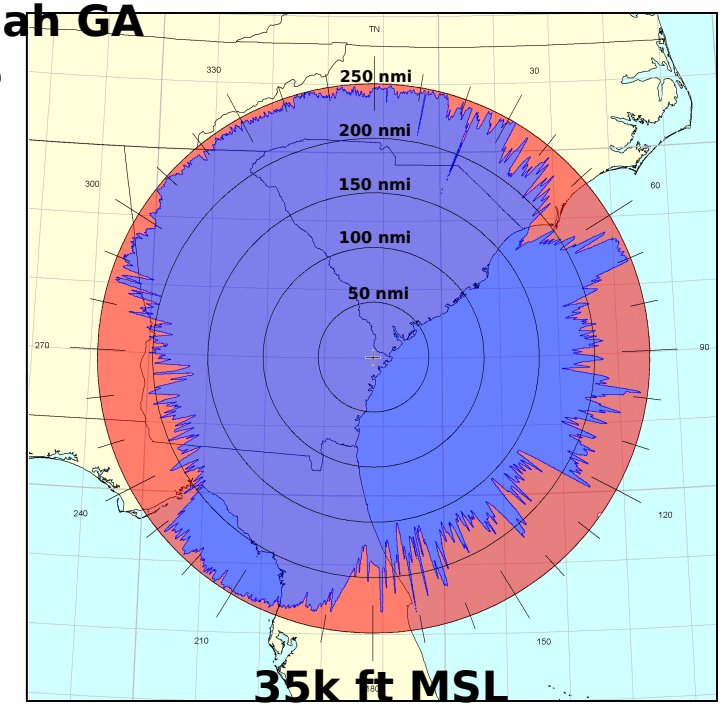


117 ACS Savannah GA
AN/TPS-75



2k ft AGL

DTED Only
DTED +
Survey



35k ft MSL

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QUESTIONS??

Solar Azimuth Formula

Hand Jammin’

- Required data
  - Latitude
  - Longitude
  - Greenwich hour angle (GHA) for upcoming time from Air Almanac
  - Declination (DEC) for upcoming time from Air Almanac
- Compute Local Hour Angle (LHA)
  - LHA = GHA + EAST LONGITUDE
  - LHA = GHA – WEST LONGITUDE
- Compute Solar Elevation Angle (Hc)
  - $Hc = \sin^{-1} (\sin DEC * \sin LAT + \cos DEC * \cos LAT * \cos LHA)$
- Compute Azimuth to the sun (Z)
  - $Z = \cos^{-1} [(\sin DEC – \sin LAT * \sin Hc) / (\cos LAT * \cos Hc)]$

Olmstead Equation

- Variables
  - a = Vertical angle
  - H = Elevation of object
  - E = Elevation of observer
  - R = Range to the object
  - K = K-factor
  - r = Earth's radius at 45° latitude (6,367,368.7 meters)
  - u = Number of feet or meters in the range measure being used
  - $Y = (u)^2 / 2rK$ meters or $(u)^2 / 2rK * .3048$ ft
- Equation
  - $a + \tan^{-1} [((H-E) – YR^2) / ur]$